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OPERATING INSTRUCTIONS FOR THE SENCORE MU140
DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER
THE CONTINENTAL

With the increased number of new tube types, such as the Novar, Compactron, Magnoval, and the newest, the 10 pin Decal, tube testing has replaced the substitution method of finding a bad tube and has become a very important part of electronic maintenance. The Continental has been designed to fulfill the need for a fast accurate tester that will detect even the slightest problem in a tube. It can make four independent tests on a tube: Dynamic mutual conductance test, full load cathode current test, a high sensitivity grid leakage test, and the famous Sencore Mighty Mite "Stethoscopic Shorts Test". If a tube has a trouble the Continental will find it.

Tubes the Continental Will Test

The Continental will test almost 3000 tubes, more than most other testers, including laboratory types. It will test all tubes used in TV, radios, car radios, hi-fi sets, industrial equipment and other electronic gear. It will test tube types that include the standard 7 and 9 pins, octal, loctal, compaction, novar, magnoval, nuvistor, and the new 10 pin decal. Tube charts are kept current, and new charts will be sent, when they become available, upon receipt of your signed warranty card. A nominal charge is made for each new chart.

In an emergency when you find it necessary to check an unlisted tube, the straight forward circuitry of the Continental permits test settings to be computed from published tube data. The procedure is covered in detail later in this manual.

Tests the Continental Will Make

In addition to the three popular tests that made the Sencore Mighty Mite famous, the full load emission test, the high sensitivity grid leakage test and the stethoscopic shorts test, the Continental will test a tube for true dynamic mutual conductance (Gm). This is a very important test on tubes used in critical circuits, because as a tube ages the tube elements can relax and change position slightly. This seriously affects normal operation of the tube. A mutual conductance test will show if this condition exists in a tube; the control grid will not have normal control of the plate current as with a good tube, and this is detected. The meter indication for the Gm test will show good or bad. However, when desired it can be converted to true micromhos by using the chart on page 10.

The Continental also provides for checking tube life expectancy during the emission or the Gm test.

Dynamic Mutual Conductance

The Continental uses a new speedy approach to measuring Gm without sacrificing accuracy. Using an ABC approach (Automatic Bias Control) eliminated the need for plate and screen voltage controls and for a grid bias control. Each tube that is put under test adjusts its bias so that a predetermined plate current (2, 7 or 25 MA) will flow; the DC plate voltage is held fairly constant.

The tube operating conditions are thus predetermined without manually setting any controls, making the test procedure faster and also making it possible for the first time to get accurate Gm readings without a lot of extra controls.

Cathode Emission. The cathode emission check is an important check as it serves as a quality indication of the tube and will tell if the tube will be able to deliver the current needed in the circuit it is used in. The Continental uses the same basic cathode emission check as the famous Mighty Mite. It puts the full rated load on the tube so that it is operated at its normal operating level. This check is especially important in power output tubes and rectifiers.

Grid Leakage. The Continental checks for gas, or contamination, or control grid emission at a sensitivity of over 100 megohms, or less than one-half a microamp. This sensitivity is accomplished by using an expensive moving coil meter and a DC amplifier. The DC amplifier allows for the use of low test voltages so damage to the delicate frame grid tubes and nuvistors is prevented. The sensitive grid check is very important and will pick out troublesome tubes in RF, IF, AGC, sync, and other circuits that testers with sensitivities of 2 to 5 megohms will miss.

Shorts. The Continental uses the famous Sencore "Stethoscopic" shorts test and checks for shorts from each element to every other element in the tube. The voltage applied in this test is kept to a low level to prevent possible damage to the frame grid tubes, nuvistors and the shadow grid tubes. This is very important because high test voltage could cause a short that did not exist before.

CONTROLS ON THE CONTINENTAL

A. FILAMENT: 17 position filament switch to select the proper filament voltage to be applied to the tube under test.

B. LOAD: selects the proper load resistor for the tube under test for the emission test and the proper current range for the Gm test.

C. GRID: the control grid pickup for both Gm and Emission testing. Also element selector for the shorts test.

D. SCREEN: screen grid pickup for Gm testing. Is also used to isolate an extra internal connection for shorts and emission testing. Set to 0 for most tubes.

E. PLATE: plate pickup for Gm testing. Set to 0 for shorts, grid leakage and emission tests.

F. SIGNAL: selects the signal applied to the grid of the tube under test for the Gm test.

FUNCTION: selects the proper test to be applied to the tube; SHORTS, Gm-EMISSION, AND LEAKAGE. Also used to turn the power on or off.

METER ZERO: used to set the meter on zero. Same action as the zero control of VTVM. Must be set with function switch set to SHORTS or with no tube inserted in the sockets.

Gm TEST: used when checking a tube for Gm. Screen and plate potentials are not applied until this switch is pushed.

LIFE TEST: a spring loaded switch to reduce the filament voltage applied to the tube to test the life expectancy of the tube.

OPERATING THE CONTINENTAL

The Continental is a unique tube tester in that it is possible to check a tube for both emission and for mutual conductance. Most other checkers will test a tube for one or the other, but not both. Many servicemen will want to use the Continental as a fast emission tester (it's even faster than the Mighty Mite because only three controls are set up for emission) and use the Gm test as a solid backup on the real tough troubles. Others will want to use the Gm test on all tubes that have Gm listings and only use the emission test on rectifiers, diodes and power tubes.

Regardless of whether you choose the emission test or the Gm test as your standard test it is always a good idea to check all tubes for shorts and for grid leakage. Also if the emission or the Gm meter indication is just into the GOOD area make it a habit to check the tubes life expectancy, because if the tube is marginal the reading will drop off rapidly. The reading will hardly change if the tube is good.

NOTE: THE CAP LEAD SHOULD BE PLACED ON ALL TUBES HAVING CAPS

The following example shows how the Continental is set up to give a complete check on a tube. All tubes will be set-up similar to this, but the order of checks may be altered to any order you may desire. Any check may be made independently or in any order without fear of damage to the tube under test.

In the following example, you will note that no mention is made of the supressor grids although they are both independent and brought out on separate pins. In most tubes, this grid is tied back to the cathode inside the tube envelope. In the Continental if the grid is not connected internally it is tied back to the cathode automatically with the C GRID switch. This eliminates any need for a supressor grid set up switch.

Locating the Tube Settings. The tube chart located in the cover contains the tube listings and set-up information for the Continental. The tubes are listed in numerical and alphabetical order for ease of location. The example below shows the 6AR11 as it is listed in the chart. Note, after the tube listing, the filament is next, followed by the socket in which the tube will be tested. The next two groups are the Emission settings and the Gm settings respectively.

TUBE	FIL A	SKT	EMISSION (Set E & F to Zero)			MUTUAL CONDUCTANCE				
			B	C	D	B	C	D	E	F
6AR11	6	9	D	5	0	M	5	3	2	30
	6	9	D	10	0	M	10	9	8	30

Any special information or procedures such as the normal shorts in the tube will be listed directly below the tube in the chart.

Shorts Test. The shorts test should be the first test made. If the tube has internal shorts, then no further checking is necessary. First locate the tube in the chart (in this example, the 6AR11). Set the A FILAMENT switch to the proper filament voltage, 6. Then plug the tube into the correct socket. For the 6AR11, the chart shows 9, a compactron socket. The D SCREEN, E PLATE, and F SIGNAL switches are all set to 0. This will be the normal position for these switches for all Shorts, grid Leakage and Emission tests. In some cases, the D SCREEN switch will be

used to isolate an extra internal connection to allow the checking of the tube. Set the C GRID switch to H-K position and the Function switch to SHORTS. Rotate the C GRID switch through all of its positions slowly while observing the SHORTS light. If the SHORTS light glows, it indicates a short in the tube. Dimily lit electrodes in the SHORTS light indicate gas or leakage in the tube. Some tubes may cause the SHORTS light to light on one position only of the C GRID switch. This may occur in some multifunction tubes containing one or more diodes, or in certain dual section tubes where the supressor of one section is connected to the cathode of the other section causing the SHORTS light to light on one position only of the C GRID switch. If a short is indicated in more than one position of the switch, the tube has a short and should be rejected unless otherwise indicated in the set-up book. Tubes marked with an asterisk (*) have normal shorts as indicated directly below the tube listing in the chart. Before rejecting a tube for shorts, be sure to check the tube listings for any normal shorts. Some of the tubes marked with the asterisk (*) may not show shorts as some manufacturers do not use the extra pins for internal connections while others may. If the tube shows shorts other than those listed as normal, the tube should be rejected.

Emission Test. The emission test is a very important test, especially to power output tubes and low voltage rectifiers as it will tell you if the tube will be able to deliver the required current to the circuit for proper operation. The filament setting and the socket will remain the same. The B LOAD switch will be set for the 6AR11 to D and the C GRID switch set to pick up the control grid. To test the first section of the tube, the C GRID switch will be set to 5. The FUNCTION switch is set to Gm-EMISSION and the Emission of the tube read on the top scale of the meter. A reading on the line between GOOD and ? indicates a cathode current of about 70% of rated value. Below this point, it is questionable that the tube will function properly in the circuit. If the reading falls into the BAD area, the tube will not deliver enough current and will not perform properly in the circuit. If the reading falls at the top of the meter scale, it merely indicates very good emission. If the first section passes the Emission test, the C GRID switch is then switched to position 10 as indicated in the chart to check the second half of the tube.

Please note that in many multifunction tubes, the C GRID will be different for each section, and the B LOAD may change also. Be sure to check the chart for the correct setting to insure proper testing of the tube.

Grid Leakage. The grid leakage test is very important, especially on tubes used in high impedence circuits because a tube with no shorts and good emission, can still have grid leakage that will up-set the operation of the circuit that it is used in. Grid currents as small as 0.5 microamps can cause many problems in RF, IF, sync, video, chroma, and other high impedence electronic circuits. To check a tube for grid leakage with the Continental, set it up as you did for the emission test. If you have already performed the emission test, merely set the FUNCTION switch to the GRID LEAKAGE position and read the leakage on the lower scale of the meter.

The grid leakage check may be made with the tester set up for either Gm or Emission, but it should be noted that if the grid leakage check is made with the tester set up for Gm, the screen and plate of the tube are open, and any leakage to these elements will not show up. Therefore, it is desirable to check grid leakage with the D SCREEN and E PLATE set at 0. In most cases, however, the leakage in the tube will appear between the control grid and the cathode of the tube and will show up in either check position.

Gm. The Gm test is an important test, especially on older tubes that have been used for many hours. The cathode emission of an old tube might still be satisfactory, but old age could have changed the tube's characteristics so that it will not operate properly. The Gm test will show up this condition.

To test the 6AR11 compactron for Gm, the filament switch and socket used will remain the same as for the other tests and the C GRID settings will be the same as they were for emission. The settings for the B LOAD will change to one of the last three positions of the switch, marked as Gm settings. With the 6AR11 both tube sections are set to M, but in many multifunction tubes the load settings will be different for each section. Be sure that you have the proper setting for each section to insure a correct test. The D SCREEN switch is set to pick up the screen as indicated in the chart, the E PLATE switch is set to pick up the plate pin, and the F SIGNAL control is rotated to the setting indicated in the chart, in this case 30 for both sections.

The Gm TEST switch is pushed and the condition of the Gm of the tube is read on the meter. A good tube will read in the green area and generally 100 on the meter. A reading on the line between the ? area and the GOOD area indicates a reduction to 70% of the Gm value of the tube. Note that for each section of a multisection tube, the plate and screen controls are different and in many cases the load switch is also different.

If all tests have been satisfactory, the tube is in good condition and should not be replaced.

HOW TO CHECK HORIZONTAL OUTPUT TUBE PLATES

When a Horizontal output tube is checked for Gm, all the elements are checked. Voltages are applied to the screen and plate and if the tube reads in the good area, the Gm is correct and all the elements are good. In some of the new Novar and Compactron based tubes, the tube manufacturers have added extra connections to the screen and grids. Some of these connections can not be isolated and the tube can only be given an emission check. Although the plate and screen will seldom open on a tube, the plate connection on the top of some horizontal output tubes can open with the extreme heat developed in the tube. On those that are not checked for Gm, the plate may be checked for emission to determine if it is open or not. Simply set the B LOAD switch to "J" and the C GRID switch to 10. If the plate is O.K., the meter will read. The amount of current indicated by the reading is not important as the plate will pick up only a small amount of current and the value will not change with age. The plate is either good or bad, open or connected. Tap the plate cap to be sure that the reading stays constant.

TUBE LIFE EXPECTANCY TEST

The LIFE TEST switch on the Continental will allow you to obtain an indication of life expectancy of the tube under test. This test may be performed when checking the tube for emission or for Gm. A doubtful tube may show up to a greater degree in the Gm check than in the emission check. If the reading drops off greatly under this test, the life expectancy can be considered very poor. If the reading did not drop off or dropped off only slightly the tube life is still good.

REJUVENATION

A small receiving tube may be rejuvenated on the Continental by merely increasing the filament voltage by setting the filament switch one setting higher for ten to fifteen seconds. This is considered as only a temporary measure when no replacement is on hand.

You will note that this will also accelerate the gas and leakage conditions when checking a tube for LEAKAGE. If you get a grid leakage reading in the BAD area with an increase in filament voltage, reduce the setting back to the normal voltage. If the leakage reading returns to the GOOD AREA, the tube is good and should not be rejected. If the meter remains in the BAD area, the tube should be replaced.

HOW TO DETERMINE NEW TUBE SET-UP

A tube not listed in the Continental chart may be checked and set-up quite easily from a tube manual or even a schematic in which the tube is used. The settings for the controls can be easily figured. Note that the C GRID, D SCREEN, and E PLATE controls are numbered. These numbers correspond to the pin numbers of a tube base and are set accordingly. If the plate of a tube is pin 4, the E PLATE is set to position number 4 and so on. You will note that there are several exceptions in the compactron series. A check of the schematic will show you these exceptions. If the tube has two connections for the control grid, one of them must be isolated to allow checking the tube for Gm or emission. Pick a socket that has one of the pins open and use the other pin for the C GRID pick-up. The cap lead is connected to line 10. If a tube has a plate cap, the E PLATE SWITCH should be set to 10. If the tube has a grid cap, the C GRID switch should be set to 10.

In some cases, a tube may have more than 2 connections to the control grid on the base of the tube. If the socket system on the Continental will not isolate all of them, the D SCREEN switch can be used to isolate an extra pin. Simply set the D SCREEN switch to the number of the pin to be isolated. With the D SCREEN switch set to this position, the tube can only be checked for emission. If the switch is set for Gm, it will not isolate the extra connection and therefore a check will not be possible.

The following examples will show you how a triode and a pentode are set up to be checked for Emission and Gm.

For the first example, we will use the old work horse tube, A 12AU7. The filament voltage on the tube according to the manual is 12.6 volts. The filament switch is then set to the 12 volt position. Next we must determine the load setting for the emission test. The typical operation characteristics show the plate current to range from about 10 milliamps to 12 milliamps. The load setting taken from figure 1 would then be D which would be the B LOAD switch setting. The C GRID is set up to pick up the control grids, which on the 12AU7 are pins 2 and 7. (See Fig. 2) A separate emission test must be made on both grids to check both sections of the tubes. The D SCREEN switch is set to 0 as are the E PLATE and F SIGNAL control for the emission test.

B LOAD SETTING	CATHODE CURRENT
A	50 MA +
B	20-50 MA
C	15-30 MA
D	10-16 MA
E	6-12 MA
F	2- 7 MA
G	.7- 2 MA
H	.5-.8 MA
J	.5 or less

FIGURE 1

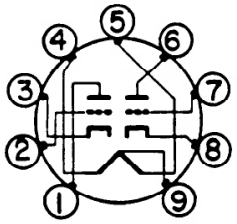


FIGURE 2, 12AU7 BASING DIAGRAM

Next, the socket in which the 12AU7 is placed for testing must be determined. A look at the base diagram shows a center tapped heater. This center tap must be isolated. A check of the 9 pin sockets on the schematic shows that socket 25 has the 9th pin left open, and this is the filament center tap. With the 12AU7 placed in this socket the center tap is isolated and the tube can be checked. If the center tap can not be isolated on a tube, use only one half of the rated filament voltage to prevent burning out the filament of the tube. This tube will then have a normal shorts indication on the shorts lite. With the center tap isolated on the 12AU7, the tube will have no normal shorts. If any shorts appear on the shorts test, the tube should be rejected.

Now that we can check the emission, shorts, and grid leakage with these settings, let's see how to check this tube for Gm.

From the base diagram we can set the D SCREEN to 0 because there is no screen grid, the E PLATE to 1, and the C GRID control remains the same. Next, we must determine the E LOAD setting for the Gm check. It will be one of the last three settings, K, L, or M. This corresponds to plate currents of 2, 7, and 25 milliamps as taken from the chart of figure 1. Our load setting for emission was based on a current of 10 to 12 milliamps so the Gm should be close to this value. The closest value in this case is the L setting of 7 milliamps. Going to the curves of figure 3 we find the 7 milliamps of plate current and follow it up until it intersects with the 100 volt curve. Then it is followed across to the Gm values. The chart indicates a value of 2600 micromhos. Referring to the chart of figure 7, we locate 2600 micromhos on the bottom line and work up until it intersects the curve. Reading across to the F SIGNAL settings, we find the setting to be 67. With the F SIGNAL control set at 67 we can now check the 12AU7 for Gm by simply pushing the Gm TEST switch and reading the meter.

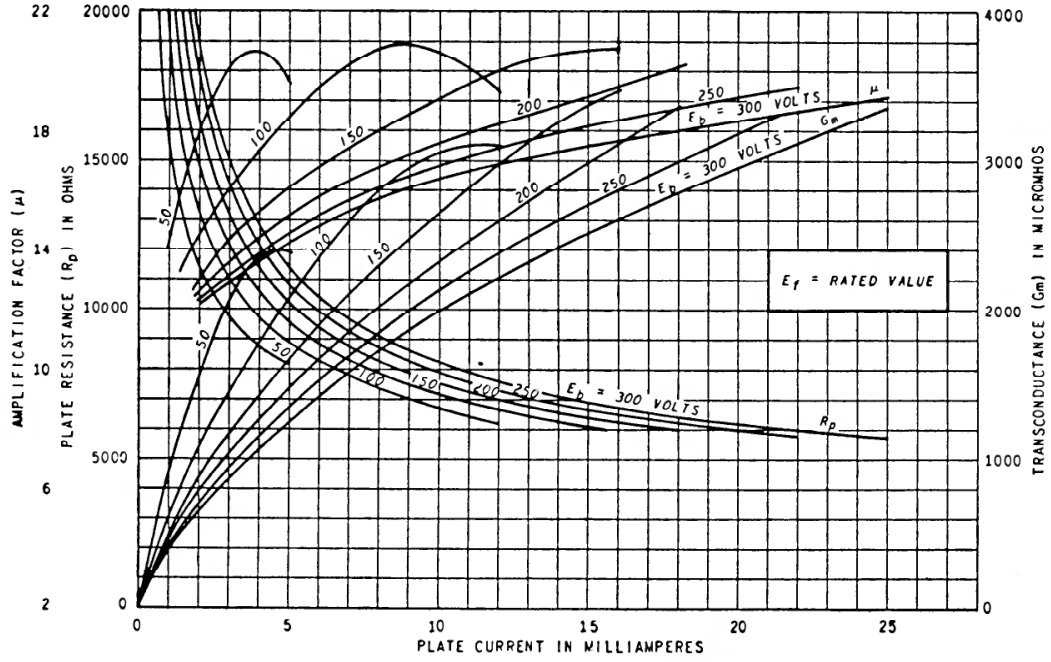


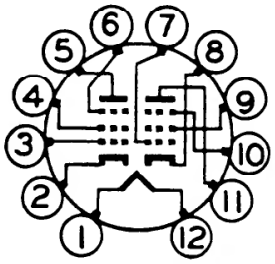
FIGURE 3, 12AU7 AVERAGE CHARACTERISTICS

The 12AU7 is a triode and easy to find the settings and test. Let's now look at a a pentode and see what is involved. The 6BN11 has been chosen. This is a compactron double pentode. In this tube both sections are similar and therefore we need to find the B LOAD and F SIGNAL settings for one section only as both sections will check identical. Of course the grid, screen and plate connections will be different for each section.

First, the filament voltage is 6 so the A FILAMENT switch is set to 6. The current listed in the typical operating section is 11 milliamps so from the chart of figure 1, we find the B LOAD setting for emission is D. The D SCREEN, E PLATE, and F SIGNAL are set to 0 for the emission test. From the tube base diagram, (see Fig. 4) the control grid is 3 so the C GRID switch is set to 3 for the emission check.

A check of the base diagram reveals no internal connections, no extra grid connections, so a standard compactron socket may be used, in this case, socket number 9. With the tube in socket 9 and the above settings, it can now be checked for emission, shorts and grid leakage.

FIGURE 4, 6BN11
BASING DIAGRAM



For the Gm check, the C GRID remains at 3, the D SCREEN is set to 4, and the E PLATE is set to 5. From the curves in figure 5, the current and bias on the tube is determined. The curve shows that with 7 milliamps of plate current and 115 volts on the screen, the bias is about 1.1 volts. Going to the curves of figure 6, find the bias of 1.1 volts and where it intersects the curve of 115 volts on the screen. Here you will have to do a little interpolation. The Gm comes out to be about 10,000 micromhos. From the chart of figure 7 we find 10,000 and where it intersects the curve and find that the F SIGNAL control setting should be 28. With the F SIGNAL control now at 28, push the Gm TEST switch and read the meter. If the tube does not read exactly on 100, this does not indicate any error, but shows the tolerance of Gm allowed in the tube. Most tubes can vary about 30 percent above and below this point and still be within manufacturing tolerances. Some industrial and military tubes will be much closer in tolerance.

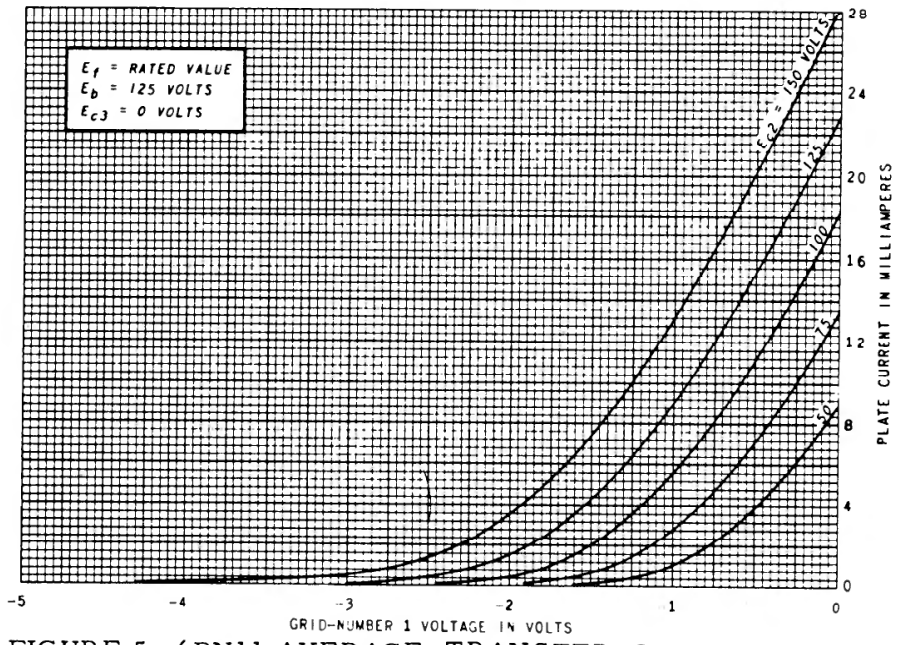


FIGURE 5, 6BN11 AVERAGE TRANSFER CHARACTERISTICS

DETERMINING THE Gm in MICROMHOS

The Continental is designed so that a fast GO-NO GO check is provided when measuring tube transconductance; you set the SIGNAL control to a given setting for a tube and the meter should read in the GOOD area if the tube is good. However, if you should desire to know the actual Gm in micromhos the following procedure can be used.

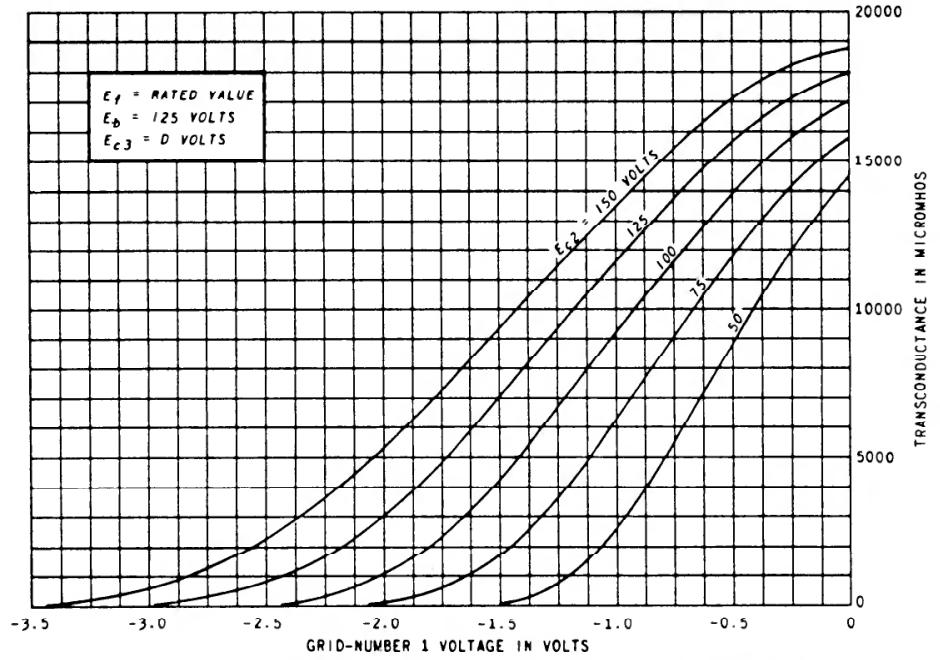


FIGURE 6, 6BN11 AVERAGE TRANSFER CHARACTERISTICS

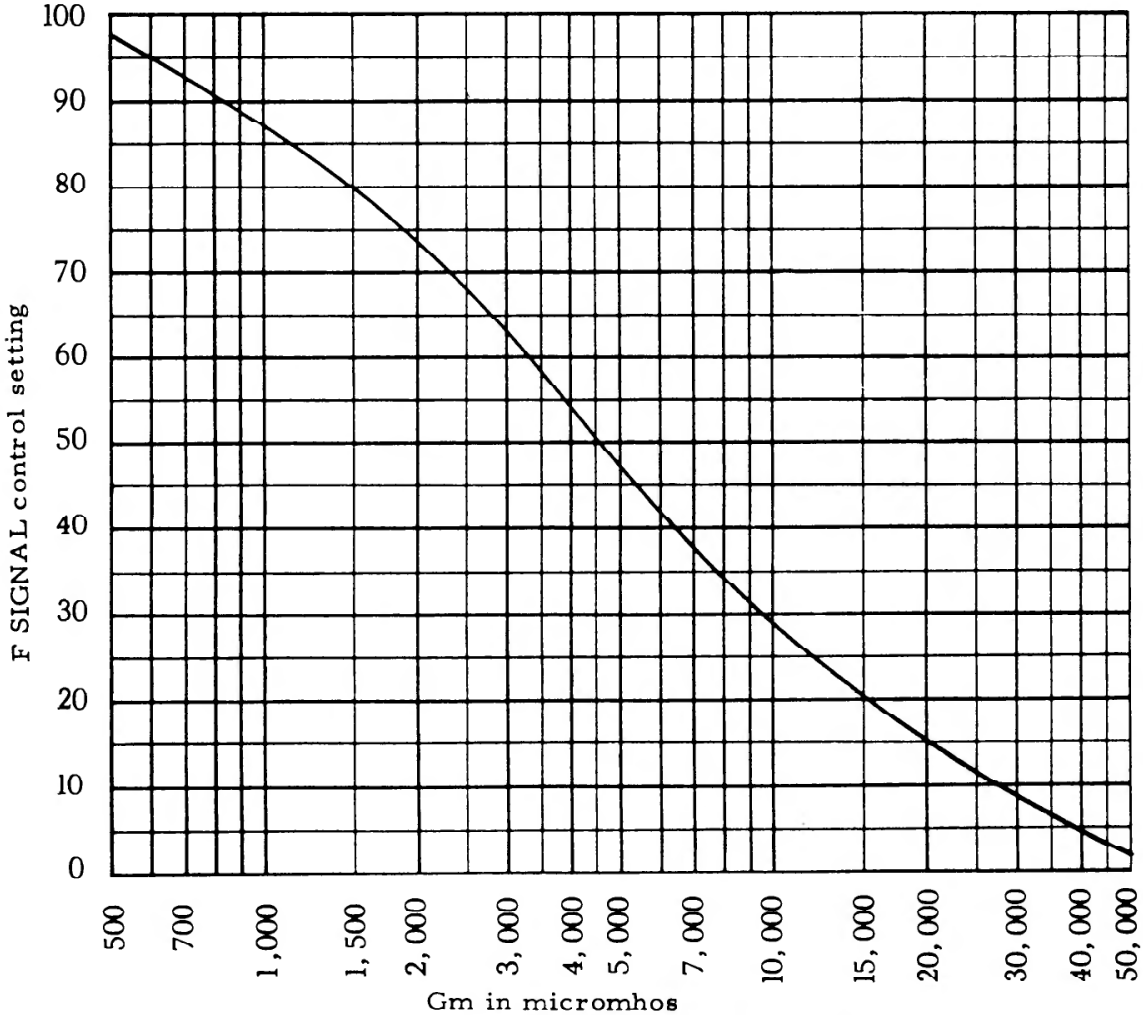


FIGURE 7, MU140 CONVERSION CHART

With the tube set up for the Gm check, push the Gm TEST switch and adjust the F SIGNAL control until the meter indicates at 100. Note the setting of the F SIGNAL control. Using the chart in figure 7 convert the SIGNAL setting to micromhos. You can compute the Gm in this manner for different values of plate current (2, 7 or 25 MA accordingly. This gives a range of Gm which can be especially helpful in some design problems.

NEW TUBE SOCKETS

The Continental has been designed to be as obsolete proof as possible. When a new tube socket becomes necessary, it is a simple matter to remove the cover plate on the front panel, exposing the four socket holes already punched in the panel for you. Simply mount the new socket in the correct hole, cut the cover to fit over the remaining holes and mount it. The socket holes are numbered to correspond with the rest of the Continental panel. If and when it becomes necessary to use the extra socket spaces, Sencore will provide the information necessary to wire up the sockets.

DISASSEMBLY INSTRUCTIONS

Disassembly of the Continental to expose the tubes for replacement or recalibration of the unit is very simple.

Remove the single screw on the rear of the case. Remove the eight screws on the front panel and separate the front panel from the case. The printed circuit board can be exposed further for replacement of parts by simply removing the two 3/8 inch nuts holding the board to the meter. The board can now be lifted away from the meter for servicing without disconnecting any leads.

INTERNAL ADJUSTMENTS

Emission Calibration:

The Emission Calibration control R34 controls the current that passes through the meter circuit. If this is off, it will affect not only the Emission readings, but the Gm and Leakage readings as well. The calibration of the emission control can be checked periodically with the simple plug-in unit described.

Take an old octal tube base or other octal plug. Insert the cathode end of a 100 PIV silicon rectifier into pin one and solder. Insert one end of a 1000 ohm resistor (preferably a 1% tolerance) into pin 3 of the plug and solder. Connect the anode end of the diode to the other end of the resistor. This completes the emission test module. This module can be inserted into sockets 1, 2, or 3 with the same results.

To check the emission calibration, plug the Continental into 115 VAC and turn the function switch to SHORTS and allow the unit to warm up for a few minutes. After the Continental has warmed up, adjust the meter zero on the front panel so that the pointer rests on the zero mark on the extreme left. Plug the above test module into socket number 1. Set the B LOAD to E, C GRID to 3, and the D SCREEN, and E PLATE to zero. Adjust R34, the control located between the 12AU7 and OB2, until the meter reads 60 or in the center of the ? area. The Emission is now calibrated.

Gm CALIBRATION

The Gm calibration on the Continental is affected not only by the controls R21 and R24, but by the control R34 in series with the meter. R34 should be checked and recalibrated if necessary before calibration of the Gm controls is attempted. See section on Emission Calibration.

The two controls, R21 and R24 control the minimum and maximum signal from the F SIGNAL control and therefore the Gm readings of the tube being tested. R24 controls the maximum signal and can be easily set using the Continental meter circuit and transistor amplifier. Connect a 1600 ohm resistor (a 1500 and 100 ohm in series) from the arm of the F SIGNAL control to the input of the transistor amplifier TR1 at the junction of C3 and R7 (see figure 8). Set the B LOAD control to A and the SIGNAL control fully clockwise. Adjust R24 until the meter reads 100. This sets the high end of the F SIGNAL control.

The low end of the F SIGNAL control must be set with a sensitive oscilloscope such as the Sencore PS127 that is capable of measuring down to 15 millivolts at a wide band response. With the Continental set as above and the 1600 ohm resistor removed, connect the vertical input of the scope to the arm of the F SIGNAL control. Set the vertical attenuator to X10 and the fine control to .5 and note the amplitude of the signal on the screen. Without touching the fine control, set the attenuator to X O. 1 and the F SIGNAL control to minimum or fully counterclockwise. Adjust R21 until the waveform on the screen is the same amplitude as previously seen on the screen of the scope. This sets the minimum signal to 1/100 times the maximum signal and establishes the correct 100 to 1 ratio for the F SIGNAL control.

CIRCUIT DESCRIPTION

The basic circuit in the Continental is the balanced meter amplifier using a 12AU7A with the meter in the cathode circuit. The diode CR12, and resistors R35 and R37 form a supression network that limits the maximum current that can flow through the meter and prevents any possible damage to the meter, even with a shorted tube. Resistor R34 calibrates the meter amplifier and is also the Emission calibration control. R36, the meter zero, is the same as the zero found on a VTVM and is adjusted in the same way. This is found on the front panel just below the meter.

CATHODE EMISSION TEST

The control grid of the tube under test is used because it was discovered that almost all the current would be picked up by this element when a tube was checked for cathode emission. The cathode is picked up by S3, the C GRID switch and connects to the emission load resistors on the B LOAD switch. The control grid, picked up by S3 also has an AC voltage applied to it from T1. The tube acts as a rectifier and the pulsating DC voltage is applied through CR8 to the filter network of C13, and R39 and then to the grid of the meter amplifier. R46, R47 and I3 help to compensate for line voltage variations. The voltage is almost pure DC at the grid of V2 and the meter deflects according to the amplitude of the DC voltage. A tube with normal emission will cause the meter to deflect into the GOOD area. A tube with about 60% of normal emission will read into the center of the ? area.

GRID LEAKAGE

The grid leakage test uses the same basic meter circuit. The control grid is tied to ground through the 10 meg resistor R39. All other elements are supplied about 37 volts positive through the FUNCTION switch S4 from the voltage divider of R31 and R32. The break between good and the ? area represents approximately 200 megohms and the break between the ? area and BAD represents approximately 100 megohms.

In use, the control grid of a tube that has grid leakage will cause a positive potential to appear across the 10 meg resistor. This voltage will cause the meter circuit to indicate. The more leakage that is present, the higher the meter will read until a dead short will cause the meter to read just about full scale. Leakage of 100 megohm or a grid emission of about 0.35 microamp would produce a leakage indication just into the BAD area.

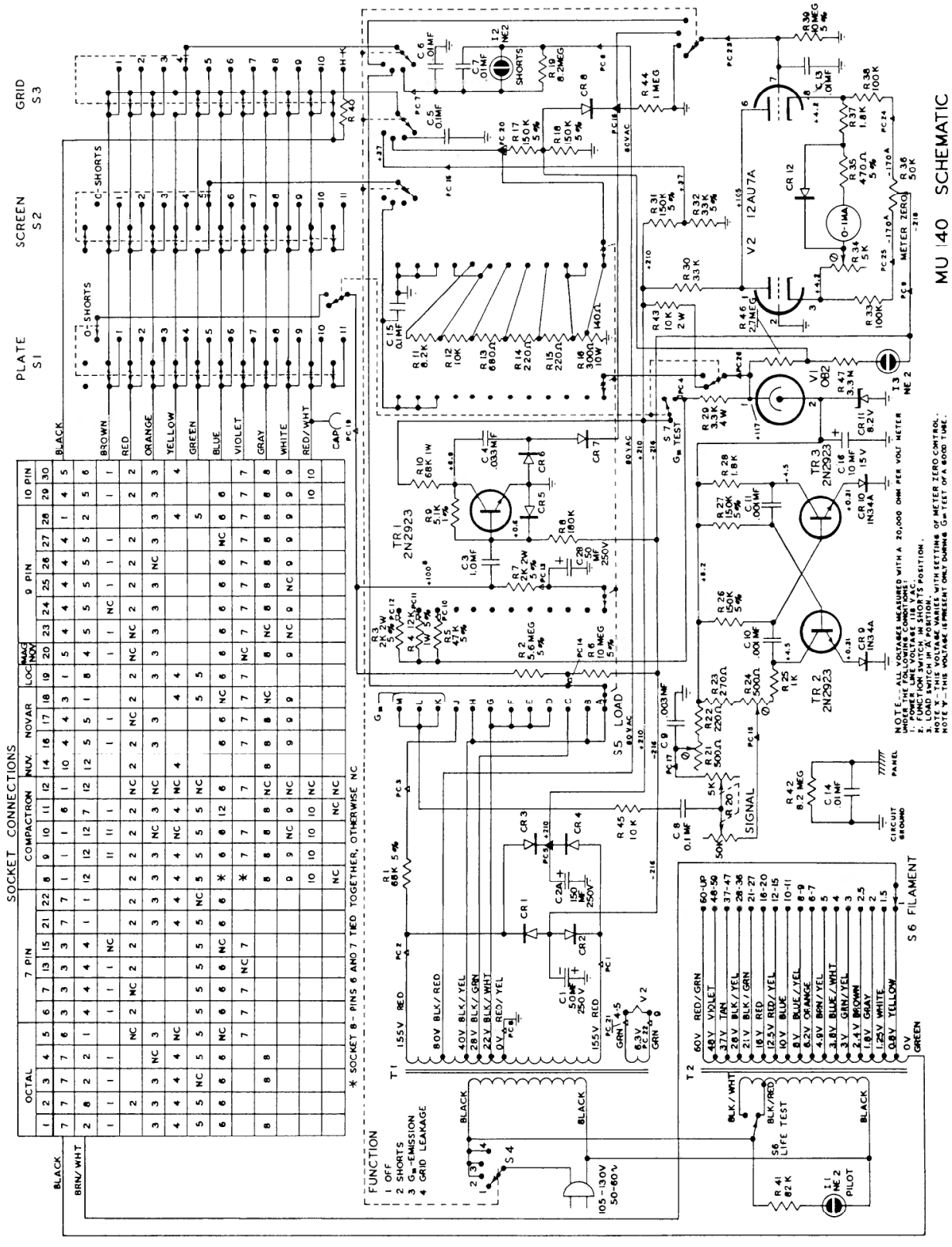


FIGURE 8, MU140 SCHEMATIC

SHORTS TEST

Shorts between elements of 180,000 ohms or less are indicated by a simple neon I2. A capacitive voltage divider consisting of C6 and C7 allow less than 40 volts to reach the elements of the tube under test. This is especially important in the newer frame grid tubes, where breakdown can occur with higher voltages applied between elements.

As the C GRID switch is rotated, each pin or element is checked against all of the other pins for shorts, gas, or leakage up to 180,000 ohms. In the H-K position of the C GRID switch, heater to cathode leakage will be indicated. A dull glow in the neon lamp indicates some leakage in the tube. The 0.1 mfd condenser in series with the neon indicating circuit reduces the effect of normal tube conduction lighting the bulb on one anode. A "true" short will light both anodes of the bulb. Disregard brief flashes in the short indicator when rotating the C GRID switch.

MUTUAL CONDUCTANCE

The Mutual Conductance or Gm circuit of the Continental utilizes a unique circuit we call "ABC" (Automatic Biasing Control) to select the proper bias and to hold the plate voltage at a constant level to obtain a true Gm reading on the tube under test. Resistors R2 and R6 form a voltage divider between the plate of the tube under test, and the negative power supply line. The plate connects to the top of R2 and the control grid to the junction of R2 and R6. As the plate current in the tube under test rises, it causes the positive voltage at the plate to drop. This in turn increases the negative bias on the control grid of the tube which brings the plate current back to the original level. This arrangement regulates the plate current and sets the bias on any tube that is being checked in the Continental for Gm. The current ranges selected by the B LOAD switch are 2, 7, and 25 milliamps. The ABC system adjusts the plate voltage at these current levels to approximately 100 volts DC. The screen voltage for pentodes is regulated to 115 volts DC by the voltage regulator OB2 V1, and the zener diode CR11. The zener diode also regulates the collector supply voltage to the signal multivibrator (TR2 and TR3). The signal multivibrator generates a 5,000 cycle square wave that is used as the Gm signal. The F SIGNAL control, R20, controls the amount of the 5,000 cycle square wave that is fed to the control grid of the tube under test. R21 and R24 are used to set the 100 to 1 ratio and the maximum voltage available from R20.

When the Gm TEST switch is pushed, the plate and screen voltages are applied to the corresponding elements of the tube. The signal applied to the control grid is amplified by the tube being tested at the desired plate current selected by the B LOAD switch, and the amplified signal is taken off the load resistor, R7. This signal is then coupled to the transistor amplifier TR1 and its output is rectified by the voltage doubler CR6, CR7, C4 and C13. This DC voltage is applied through the function switch to the meter circuit. The meter indicates in proportion to the DC voltage applied. When the tube has a Gm of its indicated value from the tube manual, the meter will read at 100. Any deviation from this indicates the amount the Gm varies from the listed value.

WARRANTY AND SERVICE INSTRUCTIONS

You have just purchased one of the finest pieces of test equipment on the market today. Although the Continental has been designed for maximum reliability with solid state circuits and vacuum tube voltmeter, there is always the possibility of something going wrong. The Continental is covered by the standard 90 day warranty as explained by the warranty policy enclosed with your instrument.

For best service on out of warranty work, the Continental should be returned to the factory service department. Be sure to state the nature of your trouble to insure faster service. If you wish to repair your own tester, we have included a schematic and parts list as well as a chart for location of the troubles you may encounter. Special replacement parts are available and may be ordered direct from the factory service department.

We reserve the right to examine defective components before an in-warranty replacement part is issued.

TROUBLE CHART

Sympton	Probable Cause	Corrective Measure
Tube reads on emission, short and leakage but no Gm indication	C GRID, D SCREEN, E PLATE set wrong	Check settings of all controls
	OB2 not firing	Check OB2 for emission with MU140
	Multivibrator not operating	Check multivibrator with scope
	TR1 not amplifying signal	Check TR1 and components
	Signal rectifiers open or shorted	Check CR6 and CR7 for open or short
	Zener diode shorted	Check CR11 for short
Reads excessively high or low on Gm and emission	R34 misadjusted	Check calibration of R34 as described under "Internal adjustments" in manual
Shorts lite works, all other functions do not. Meter zero has no effect	Defective 12AU7	Check 12AU7
	Meter	Check meter for open
	Function switch	Check function switch for open contacts
	No B + or B -	Check B + and B - with meter check
		CR1, 2, 3 and 4 for open or shorts
Shorts lite works all other functions do not. Meter can be zeroed with meter zero adjust.	Function switch	Check function switch for open or poor contacts
	Defective capacitor	Check C13 for short
Short lite has excessive brilliance. Lites on tubes with no shorts	Function switch	Check function switch for shorted contacts
Tube reads on Gm shorts and leakage but not emission	Defective transformer	Check voltage from T1
	Defective diode	Check CR8 for open

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